

**(19) World Intellectual Property
Organization
International Bureau**



(43) International Publication Date
4 November 2004 (04.11.2004)

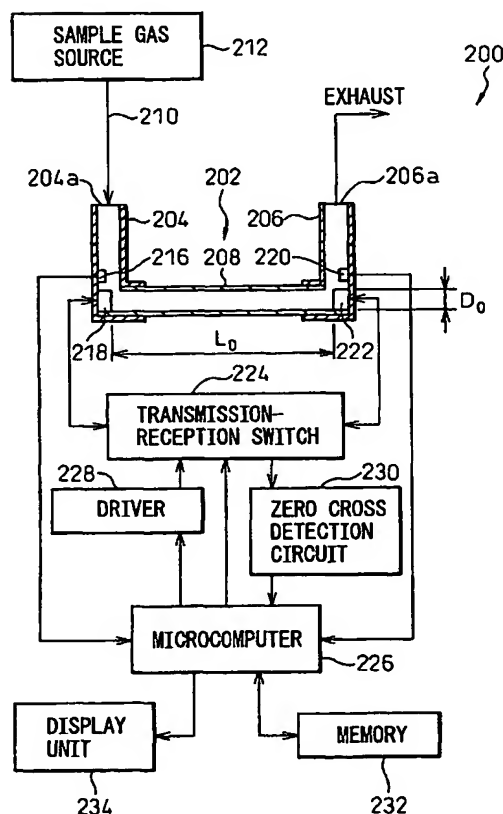
PCT

(10) International Publication Number
WO 2004/094960 A3

- | | |
|--|--|
| <p>(51) International Patent Classification⁷:
G01N 29/02</p> <p>(21) International Application Number:
PCT/JP2004/005590</p> <p>(22) International Filing Date: 20 April 2004 (20.04.2004)</p> <p>(25) Filing Language: English</p> <p>(26) Publication Language: English</p> <p>(30) Priority Data:
 2003-115333 21 April 2003 (21.04.2003) JP
 2003-168911 13 June 2003 (13.06.2003) JP
 2003-271779 8 July 2003 (08.07.2003) JP</p> <p>(71) Applicant (for all designated States except US): TEI-
JIN PHARMA LIMITED [JP/JP]; 1-1, Uchisaiwaicho
2-chome, Chiyoda-ku, Tokyo 1008585 (JP).</p> | <p>(72) Inventor; and
(75) Inventor/Applicant (for US only): FUJIMOTO, Naoto-
shi [JP/JP]; c/o Teijin Pharma Limited, Tokyo Research
Center, 3-2, Asahigaoka 4-chome, Hino-shi, Tokyo
1910065 (JP).</p> <p>(74) Agents: AOKI, Atsushi et al.; A. AOKI, ISHIDA & AS-
SOCIATES, Toranomon 37 Mori Bldg., 5-1, Toranomon
3-chome, Minato-ku, Tokyo 1058423 (JP).</p> <p>(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG,
KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG,
MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH,
PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.</p> |
|--|--|

[Continued on next page]

- (54) Title: ULTRASONIC APPARATUS AND METHOD FOR MEASURING THE CONCENTRATION AND FLOW RATE OF GAS**



(57) Abstract: ABSTRACT An ultrasonic apparatus measures the concentration and flow rate of a sample gas by calculating a possible propagation time range on the basis of the gas temperature, determining whether or not the phases at which two first trigger signals; respectively generated on the basis of forward and backward waveforms of the ultrasonic waves, coincide with each other, processing the zero-cross signals so that the phases coincide with each other, obtaining reference zero-cross time instant by calculating mean value of the forward and backward zero-cross time instants, obtaining an ultrasonic reception point by subtracting an integral multiple of the cycle of the ultrasonic waves so that the results of the subtraction falls into a possible propagation time range and estimating the ultrasonic propagation time on the basis of the ultrasonic reception point.



(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:

16 June 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP2004/005590

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01F1/66 G01N29/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01F G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 052 230 A (STEINACHER MICHAEL ET AL) 1 October 1991 (1991-10-01) column 5, line 16 - column 6, line 49; figures 2,3,17 column 20, line 26 - column 23, line 39 figures 1-3,17,18	1-18
A	EP 1 286 159 A (TEIJIN LTD) 26 February 2003 (2003-02-26)	1-18
Y	the whole document	19-22
A	US 5 123 286 A (BAUMGAERTNER MANFRED) 23 June 1992 (1992-06-23) the whole document	1,7
	----- -/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the International filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the International filing date but later than the priority date claimed

"T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

15 March 2005

Date of mailing of the international search report

26. 04. 2005

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Politsch, E

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP2004/005590

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 0070, no. 38 (P-176), 16 February 1983 (1983-02-16) & JP 57 190281 A (HOKUSHIN DENKI SEISAKUSHO:KK), 22 November 1982 (1982-11-22) abstract	1,7
Y	----- US 4 325 262 A (MEISSER ET AL) 20 April 1982 (1982-04-20) column 1, line 65 - column 4, line 22; figures 1-5	19-22
Y	----- FR 2 462 837 A (LANDIS ET GYR ZUG AG) 13 February 1981 (1981-02-13) page 7, line 19 - last line ; figure 5	19-22
Y	----- EP 0 606 536 A (LANDIS & GYR BUSINESS SUPPORT AG; LANDIS & GYR TECHNOLOGY INNOVATION A) 20 July 1994 (1994-07-20) page 2, line 38 - page 4, line 39; figures	19-22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/005590

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-18

These claims concern improved ultrasonic wave propagation time measurement in an ultrasonic apparatus and method for measuring the concentration and flow rate of gas. The common special technical feature of these claims is the inference of a reference zero-cross time instant from a plausibility check by subtracting an integral multiple from the phase-aligned average of the measured forward and backward propagation time.

2. claims: 19-22

These claims concern the signal/noise ratio optimization of an ultrasonic concentration measurement apparatus. The common special technical feature of these claims is the choice of the geometric proportions of the distance between the ultrasonic transducers and the respective ends of the flow conduit dependent on ultrasonic sound velocity, inner conduit radius and frequency. It is noted that the inequation given in claim 19 is obviously erroneous.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/JP2004/005590

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5052230	A	01-10-1991	DE 3823177 A1 DE 3843678 A1 DE 58905910 D1 DK 59290 A WO 9000723 A1 EP 0378651 A1 JP 7078438 B JP 2502757 T	11-01-1990 28-06-1990 18-11-1993 27-04-1990 25-01-1990 25-07-1990 23-08-1995 30-08-1990
EP 1286159	A	26-02-2003	JP 2002214012 A JP 2002214203 A CA 2403862 A1 EP 1286159 A1 CN 1455865 A WO 02057770 A1 TW 520993 B US 2003136193 A1	31-07-2002 31-07-2002 20-09-2002 26-02-2003 12-11-2003 25-07-2002 21-02-2003 24-07-2003
US 5123286	A	23-06-1992	EP 0452531 A1 DE 59008200 D1 DK 452531 T3 FI 911917 A JP 3022623 B2 JP 4230882 A	23-10-1991 16-02-1995 19-06-1995 21-10-1991 21-03-2000 19-08-1992
JP 57190281	A	22-11-1982	NONE	
US 4325262	A	20-04-1982	CH 636701 A5 AT 384299 B AT 284280 A BE 883501 A1 DE 2924561 B1 DK 246980 A , B, FR 2458798 A1 GB 2052741 A , B IT 1131289 B JP 1359332 C JP 55166009 A JP 61025291 B NL 8003340 A , B, SE 8004210 A	15-06-1983 27-10-1987 15-03-1987 15-09-1980 31-07-1980 09-12-1980 02-01-1981 28-01-1981 18-06-1986 13-01-1987 24-12-1980 14-06-1986 10-12-1980 09-12-1980
FR 2462837	A	13-02-1981	CH 642503 A5 DE 2934031 B1 DK 330480 A , B, FR 2462837 A1 IT 1132256 B NL 8004410 A , B, SE 441639 B SE 8005519 A	13-04-1984 09-10-1980 03-02-1981 13-02-1981 02-07-1986 04-02-1981 21-10-1985 03-02-1981
EP 0606536	A	20-07-1994	DE 59308386 D1 DK 606536 T3 EP 0606536 A1	14-05-1998 11-01-1999 20-07-1994